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CONTENTS

		Page
1.0	Introduction	1
	1.1 Terrain Mapping Program	2
	1.2 Previous Work	2
2.0	Geologic Setting	2
	2.1 Bedrock Geology	3
	2.2 Quaternary Geology	3
	2.3 Physiography	4
3.0	Engineering Terrain Units	5
	3.1 Bedrock	5
	3.2 Moraine	7
	3.3 Glaciofluvial	11
	3.4 Organic	12
	3.5 Eolian	13
	3.6 Alluvial	14
4.0	References	15

TABLE

1 – Summary of terrain unit characteristics and engineering significance 8

FIGURE

1 – Diagrammatic sketch showing typical terrain types and their representative letter symbols 6

MAP
(accompanying report)

Map 5016 (coloured) – Northern Ontario Engineering Geology Terrain Study, Data Base Map, Wenebegon Lake (NTS 41O/SW). Scale 1:100 000.

Northern Ontario

Engineering Geology Terrain Study 86

WENEBEGON LAKE AREA

(NTS 41O/SW)

Districts of Algoma and Sudbury

by

M. A. Roed[1] and D. R. Hallett[2]

1.0 INTRODUCTION:

This report contains an inventory of regional engineering terrain conditions in the Wenebegon Lake area, Districts of Algoma and Sudbury. It forms part of a series of publications which provide similar terrain data for some 370 000 km^2 of northern Ontario.

The area, which covers NTS block 41O/SW, lies between Latitudes 47°00′N and 47°30′N and Longitudes 83°00′W and 84°00′W. The principal economic activity in this sparsely populated area is forestry. Tourism and mineral exploration are important seasonal activities.

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1.1 TERRAIN MAPPING PROGRAM:

The purpose of the mapping is to provide a guide for engineering and resource planning functions at a level of detail consistent with a scale of 1:100 000. The terrain information is contained on the Data Base Map (OGS Map 5016, accompanying this report).

Interpretation of black and white aerial photographs, at a scale of approximately 1:50 000, was the primary method of obtaining this terrain information. The interpretation includes information from relevant published literature. The main roads in the area were traversed during the summer of 1977 to provide spot checks of the office studies. Thus, the map represents a reconnaissance overview of the engineering conditions of the terrain.

An engineering terrain legend was developed to facilitate the mapping and to provide a common information base for the entire map series. This legend is shown on the accompanying Data Base Map. Further information on the mapping techniques, legend format, and possible uses of the map is available in the "Ontario Engineering Geology Terrain Study Users' Manual" (Gartner, Mollard and Roed, in preparation), a companion publication to this series of maps and reports.

1.2 PREVIOUS WORK:

There have been no previous engineering geology studies undertaken within the area. The surficial deposits have been mapped on a reconnaissance basis by Boissonneau (1965, 1968). Other relevant surficial geology studies can be found in Prest (1969, 1970), Prest *et al.* (1967), Thurston *et al.* (1977), the Ontario Land Inventory (1976), and Skinner (1969). Regional bedrock geology has been compiled by Giblin and Leahy (1976) and Ayres *et al.* (1971), and discussed by Thurston *et al.* (1977). Mineral potential has been summarized by Springer (1977).

2.0 GEOLOGIC SETTING:

A discontinuous mantle of Quaternary surficial deposits overlies crystalline bedrock of Precambrian age in the Wenebegon Lake area. The

terrain is dominated by rocky uplands and lowlands. Morainal and glaciofluvial deposits occur extensively in the northern portion of the map-area and, to a lesser extent, in the southern portion. Other terrain types include deposits of organic, alluvial and eolian origin.

Distinctive geologic features are the steep scarps and rectangular jointing pattern associated with the bedrock outcrops in the southern part of the area and the major glacial spillway coincident with the present-day valleys of the Cow River and Montreal River in the northwestern part of the area.

2.1 BEDROCK GEOLOGY:

The Wenebegon Lake area lies within the Superior Structural Province of the Canadian Shield. The western margin of the area is underlain by Early Precambrian metavolcanics and minor metasediments intruded by gabbro bodies of unknown age. Rocks of the Kapuskasing Granulite Complex occupy the extreme northwest corner (Ayres *et al.* 1971). The remainder of the map-area is underlain entirely by Early Precambrian felsic intrusive, migmatic and metamorphic rocks. Northwest- and northeast-trending diabase dikes cut all other rock types. Numerous northwest- and northeast-trending faults have been mapped. Major northwest-trending faults follow the Aubinadong and Little Aubinadong Rivers; major northeast-trending faults extend along the Goulais River and through Gong Lake.

A major occurrence of iron and several minor lead-zinc occurrences have been found in the metavolcanics in the southwest corner of the area. Mineral potential in this metavolcanic-metasedimentary belt is medium to high, particularly for iron. The remainder of the area has low potential (Springer 1977).

2.2 QUATERNARY GEOLOGY:

Northern Ontario was glaciated by continental ice sheets at least four times during the Pleistocene. However, only the deposits of the last glaciation, the Laurentide of Wisconsinan age, are preserved in the Wenebegon Lake area.

The Keewatin lobe of the Laurentide ice sheet advanced from the northeast at the beginning of the Wisconsinan (approximately 100 000 years ago) and eventually extended as far south as Minnesota (Prest 1970).

By late Wisconsinan time (approximately 11 000 years ago) the ice had receded to the Wenebegon Lake area and deposited a variety of surficial materials. Till, which was deposited directly by the ice, forms ground moraine. Hummocky moraine occurs in places and is evidence of mass disintegration of the ice sheet. Sand and gravel in glaciofluvial outwash plains and channels, and southward-trending esker complexes are representative deposits of glacial meltwaters.

The Sultan Scarp (Roed 1979), located to the north in the Chapleau and Ridout map-areas (Roed and Hallett 1979a, 1979b), is clearly recognized as an ice-contact slope and represents the only major stillstand of the Laurentide ice sheet in this region. The sand and gravel outwash plain in the northwest corner of the area is representative of a substantial outflow of meltwater from the glacial front during this stillstand. Much of this meltwater escaped to the west along the valley presently occupied by the Cow River and further west by the Montreal River, and to the south along the Wenebegon River.

Since the disappearance of the ice approximately 9 000 years ago (Prest 1970), eolian sands have been deposited in places, modern streams have developed alluvial flood plains, and organic deposits have accumulated in wet depressions. These non-glacial deposits, together with the various glacial deposits, complete the spectrum of Quaternary unconsolidated materials that form a discontinuous mantle over the bedrock in this map-area.

2.3 PHYSIOGRAPHY:

Rugged bedrock uplands occur extensively in the southern two-thirds of the map-area. Much of the local relief is high (greater than 60 m). Relief is moderate (between 15 and 60 m) on most of the morainal landforms and low (less than 15 m) in the glaciofluvial terrain. Elevations (above sea level) range from a low of less than 366 m along the Aubinadong River and the Montreal River to a high of 671 meters near Gong Lake in the southern part of the area.

Steep-sided gullies occur in places and are designated on the map by the symbol (++++). This symbol was inadvertently left off the map legend.

3.0 ENGINEERING TERRAIN UNITS:

Engineering terrain units are composed of a combination of various materials (unconsolidated and/or bedrock) which form recognizable landforms with certain engineering characteristics. Major terrain unit groups, and the engineering significance of each, are discussed in detail. These include bedrock terrain (RN), moraine (MG, MH), glaciofluvial outwash (GO), eskers (GE), and kames (GK), and organic terrain (OT). Less significant terrain units include alluvial (AP) and eolian deposits (ED). A diagrammatic sketch of a typical terrain setting is given in Figure 1. Table 1 summarizes the characteristics and engineering significance of all major terrain units.

3.1 BEDROCK:

Examples:

$$\frac{\text{RN(tsMG)}}{\text{Hu-D}} \qquad \frac{\text{RN(tsMG)}}{\text{Mu-D}} \qquad \frac{\text{RN(tsMG)}}{\text{Hjn-D}}$$

Bedrock terrain (RN), which dominates the southern half of the Wenebegon Lake area, constitutes ground that is underlain mainly by bedrock, either at surface or within 1 to 2 m of the surface. There is very little overburden in this unit, although patches of ground moraine (MG) till occur throughout and organic terrain (OT) containing peat deposits occurs in poorly drained depressions. Small eskers, crevasse fillings, and drumlins also occur. Most of the bedrock terrain is of high relief (H) and is rugged (j) to knobby (n) in character. Many scarps and steep-sided gullies occur along the Aubinadong and Little Aubinadong Rivers and Hamper Creek.

The principal engineering significance of bedrock terrain is that it is difficult and expensive to excavate. Blasting is required for all subsurface excavations. Extensive cut-and-fill operations are required in rugged terrain for transportation route construction, in order to eliminate extreme horizontal and vertical alignments. Many small sand, gravel, and

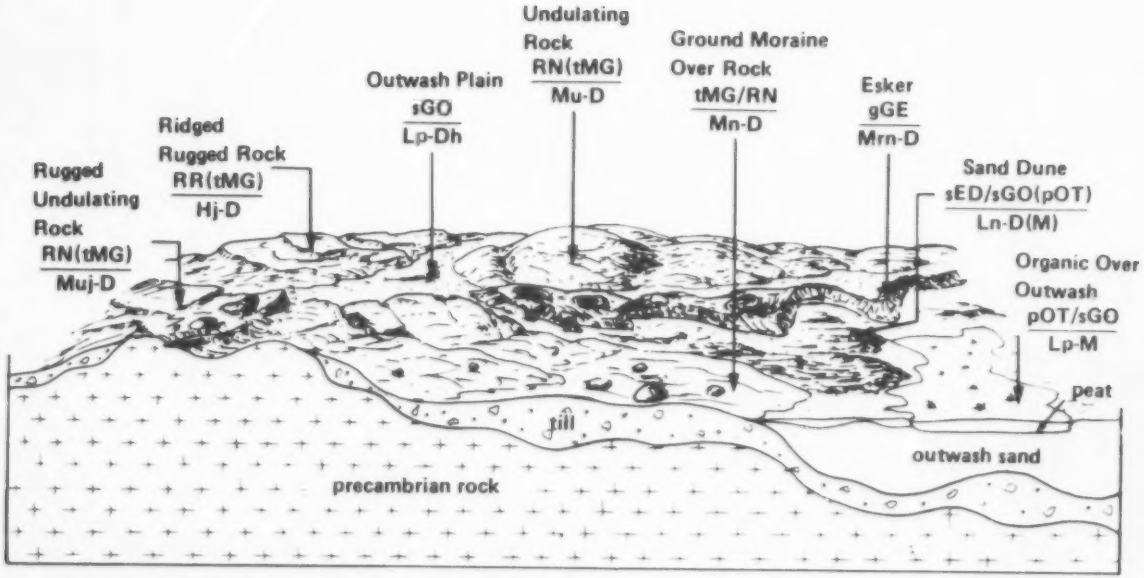

FIGURE 1 – DIAGRAMMATIC SKETCH SHOWING TYPICAL TERRAIN TYPES AND THEIR REPRESENTATIVE LETTER SYMBOLS.

till deposits scattered throughout the terrain provide adequate material for minor access road construction. However, for major transportation routes, aggregate is often imported from considerable distances at high cost.

Bedrock terrain provides excellent foundation conditions in areas that are unaffected by faults and where fracture or joint density is low. The unit also possesses considerable potential for aggregate obtained in rock quarry operations.

Groundwater potential is generally poor in bedrock terrain, but is usually sufficient for scattered domestic demand. Considerable groundwater production can be expected in fractured localities or in fault zones. Bedrock is unsuitable for waste disposal except where a thick layer (at least 1.5 m) of soil material is present.

3.2 MORAINE:

Examples:

$$\frac{tMG(RN)}{Mun\text{-}D} \qquad \frac{tMG(RN)}{Hu\text{-}D} \qquad \frac{tMG}{Lu\text{-}D}$$

$$\frac{tMG(RN)(pOT)}{Mu\text{-}M} \qquad \frac{tMH}{Ln\text{-}D} \qquad \frac{tMH(pOT)}{Mn\text{-}D(M)}$$

Morainal landforms in this map-area are either ground moraine (MG) or hummocky moraine (MH).

Ground moraine (MG) consisting of sandy till (ts) occurs extensively throughout the northern part of the map-area as a major terrain unit or as a subordinate unit in bedrock terrain. The till varies from 1 m to more than 7 m in thickness and commonly occupies rolling terrain of low (L) to moderate (M) relief with undulating (u) to slightly knobby (n) topographic character. Some ground moraine in the western portion of the area has high relief (H). The overall drainage is good (D). Low, rounded, rocky hills (RN) and near-surface bedrock (/R) occur within the ground moraine, as does organic terrain (OT) in poorly drained depressions (W). Patches of glaciofluvial sand and gravel, eskers, kames,

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Northern Ontario
Engineering Geology Terrain Study 86

WENEBEGON LAKE AREA

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TABLE 1 SUMMARY OF TERRAIN UNIT CHARACTERISTICS AND ENGINEERING SIGNIFICANCE.

Terrain Unit	Principal Materials	Topography / Drainage	Workability as Construction Material / Permeability	Shearing Strength / Bearing Value	Compaction / Compressibility
Rock Terrain (R)	rock	irregular / dry	not applicable / medium (fracture)	excellent / excellent	not applicable / not applicable
Hummocky Moraine (MH)	till, sand boulders	hummocky / dry	good / medium	good / good	good / low
Ground Moraine (MG)	till, sand boulders	knobby / dry	good / medium	good / good	good / low
Eskers (GE) Kame (GK)	sand gravel	kettled & ridged / dry	excellent / high	excellent / excellent	excellent / low
Outwash (GO) Delta (GD)	sand, gravel	hummocky-planar / dry	excellent / high	excellent / excellent	excellent / low
Glaciolacustrine Plain (LP)	clay, silt fine sand	planar / dry	poor / low	fair / fair	poor / high
Glaciolacustrine Beach (LB)	sand	planar / dry	good / high	good / good	good / low
Alluvium (AP)	sand, silt clay	channelled / mixed	fair / medium	good / poor	fair / medium
Eolian (ED)	sand	ridged, hummocky / dry	fair / high	good / good	good / low
Colluvium Soil (CW,CS)	clay, silt	sloped / mixed	poor / low	poor / poor	poor / high
Colluvium Talus (CT)	rubble	sloped / dry	poor / high	good / poor	poor / low
Organic (OT)	peat	planar / wet	poor / medium	poor / poor	poor / high

Notes:
1. The rating above or below the bar refers to the characteristic or use above or below the bar, respectively, in the column heading.
2. Permeability, compressibility, and frost susceptibility are rated as low, medium, or high; all other characteristics and uses are rated as poor, fair, good, or excellent.

Slope Stability / Frost Susceptibility	Aggregate Supply / Foundations	Highway Subgrade / Route Location	Hydro Easements / Pipeline Routes	Septic Tank Suitability / Solid Waste Landfill	Domestic Groundwater Potential / Large Groundwater Supplies
good (some talus) / not applicable	not applicable / excellent	poor / fair	fair / poor	poor / poor	good / poor
good / low	fair / good	good / good	good / good	excellent / excellent	excellent / good
good / low	fair / good	good / good	fair / fair	excellent / good	good / fair
excellent / low	excellent / excellent	excellent / excellent	good / good	poor / poor	excellent / excellent
excellent / low	excellent / excellent	excellent / excellent	excellent / excellent	poor / poor	excellent / excellent
poor / high	poor / fair	poor / good	good / good	fair / fair	fair / poor
excellent / low	good / good	good / good	good / good	poor / poor	good / poor
fair / medium	poor / poor	poor / poor	poor / poor	poor / poor	good / fair
good / low	poor / good	fair / good	good / good	fair / poor	good / fair
poor / high	poor / poor	poor / poor	poor / poor	poor / poor	fair / poor
good / low	poor / poor	poor / poor	poor / poor	poor / poor	poor / poor
poor / high	poor / poor	poor / poor	poor / poor	poor / poor	poor / poor

3. This is a generalized table intended for use in a number of reports; therefore, all terrain units dealt with in the table will not necessarily appear in each report.

and hummocky moraine are also associated with the ground moraine. Geological contacts with these units are normally abrupt, except in the case hummocky moraine and rock terrain where the contacts are often gradational. Drumlinoid features are predominantly oriented toward the southwest.

Hummocky moraine (MH) also consists of sandy till (ts) and occurs in a large 26 km^2 deposit around Prairie Grass Lake in the centre of the map-area. Smaller deposits occur along the eastern boundary of the area. The thickness of the till is much more variable than in ground moraine and may be as much as 30 m in some localities. Although till (t) is the principal material, stratified sand (s) and gravel (g), pockets of silt (M), and local concentrations of boulders (b) occur in places. Patches of organic terrain (OT) occur extensively throughout the hummocky moraine. Eskers, kames, and rock knobs are also common. Local relief is generally less than 40 m, and the character of the surface is knobby (n) or hilly and sometimes kettled (K) and dissected (d). Drainage is good (D) except in closed depressions between knobs of till and along poorly developed seepage paths.

Large boulders, patches of poorly drained ground, and the possibility of near-surface bedrock are the principal engineering difficulties that may be encountered in the ground moraine unit. Generally, however, ground moraine poses few serious construction problems and is superior to bedrock terrain for route construction because grades are lower and the necessity for rock blasting is less probable. Pockets of granular material occur, and the till itself is amenable to beneficiation in some localities. Foundation conditions are generally good in till terrain. Groundwater potential is fair where the till unit attains an adequate thickness. Where the till is at least 1.5 m thick, it is suitable for septic system installation.

The engineering significance of the hummocky moraine is substantial. The texture of the till makes the unit suitable for use in the large earth embankments required for roads and dams. Also, the chance of finding a sizeable source of granular material within hummocky moraine is good. Conventional construction techniques can be used throughout, except where local relief is very irregular, in large areas of associated organic terrain, or where near-surface bedrock is encountered. The till in hummocky moraine is probably the best material in the map-area

for attenuation of leachate from municipal land fills and septic drain tile fields. Groundwater potential, although inconsistent, is generally excellent; springs are common at the base of large morainal hills, especially during wet periods of the year.

3.3 GLACIOFLUVIAL:

Examples:

$$\frac{\text{sgGO(sED)(pOT)}}{\text{Lnp-D(D)(M)}} \qquad \frac{\text{sgGO(pOT)}}{\text{Lkp-D(M)}} \qquad \frac{\text{sgGO}}{\text{Lp-D}}$$

$$\frac{\text{sgGO(pOT)}}{\text{Lp-D(M)}} \qquad \frac{\text{sgGO(tMG)(pOT)}}{\text{Ln-M}} \qquad \frac{\text{gGE}}{\text{Ln-D}} \qquad \frac{\text{sgGK}}{\text{Mkn-D}}$$

Large tracts of land in the northeastern corner of the Wenebegon Lake area are underlain by glaciofluvial outwash (GO) composed of sand (s) and gravel (g). Most outwash occurs in the form of undulating (u) to knobby (n) plains (p) of low relief (L) that are sometimes dissected (d), kettled (k), and pitted. Often the upper 2 m of the deposit consists of fine- to coarse-grained sand. This is underlain by stratified pebble to cobble gravel which, in places, is probably greater than 5 m thick. Interbedded sand and gravel layers may occur at depth. The maximum thickness of this outwash unit may be in the order of 40 m; this estimate is based on the extent of the deposit, especially in the northern part of the map-area, and the fact that rock terrain with relief in this range has been completely covered. Associated subordinate landforms include eolian sand (sED), organic peat deposits (pOT) in wet depressions (W), and some ground moraine till (tMG). The overall drainage is good (D). Other outwash plains and terraces (t) located along the bedrock-controlled stream valleys are not usually as thick or extensive; rock knobs (RN) and associated organic terrain (OT) are subordinate landforms in these areas. In the northwest corner of the area, the Cow River and, further to the west, the Montreal River follow the route of a major glacial spillway presently marked by a narrow band of outwash.

Eskers are numerous in the northeastern quarter of the map-area, but are not nearly as extensive as those in the Ridout and Chapleau areas (Roed and Hallett 1979a, 1979b) to the north. The eskers occur as southward-trending, continuous or discontinuous, sinuous, hummocky to rolling

ridges of sand and gravel flanked by gently rolling outwash plains. Local relief on an esker is usually in the order of 10 to 15 m; pits, kettle lakes, and isolated steep sided knobs are common. Most of the eskers appear to be composed of sand and gravel in more or less equal proportions, but minor till inclusions and an upper mantle of till occur in places. In the esker core and also where the slopes are steep, gravel is usually the dominant constituent. Not all eskers are topographically prominent, since some have been buried by more recent deposits.

Kames consist of irregular groups of hills composed of sand, gravel, and till. These landforms differ from eskers in that they are not ridge-like and the internal composition is more heterogeneous and variable. Otherwise they are similar to eskers. A notable esker-kame complex straddles Highway 129 west of Wenebegon Lake, in the northeastern corner of the area.

Eskers and kames are generally well drained, but do include minor patches of poorly drained organic terrain in local depressions. Buried eskers are well drained on the surface, but commonly have a high water table.

The engineering significance of glaciofluvial outwash, eskers, and kames is related to the excellent characteristics of the materials with respect to use in construction. Potential reserves of aggregate are extremely high in the northern part of the area. Transportation routes, pipelines, and air strips are most easily constructed on the flat outwash plains. Eskers also have potential as transportation routes, although the sinuous form and some steep topography are disadvantages. Foundation and general construction conditions are excellent in glaciofluvial terrain. Groundwater potential is excellent where the deposits are thick and/or where the water table is high. Glaciofluvial deposits are not suitable for waste disposal since the materials are permeable and the potential for pollution is high.

3.4 ORGANIC:

Examples:

$$\frac{\text{pOT}}{\text{Lp-W}} \qquad \frac{\text{pOT(sGO)}}{\text{Lp-M}} \qquad \frac{\text{sED/sGO(pOT)}}{\text{Lp-M}}$$

Organic terrain (OT), composed primarily of peat (p) with some silt (m) and sand (s), occurs throughout the map-area in isolated poorly drained (W) depressions within other terrain units. Large organic deposits are not numerous, but a number of moderately sized deposits occur in the southwestern part of the area. Outwash sand (sGO) is the most common subordinate landform in organic terrain.

Construction is difficult and expensive in organic terrain due to the poor drainage conditions and the low strength, low bearing capacity, high compressibility, and extremely high frost susceptibility of the soil materials. Groundwater in organic deposits is generally of poor quality and unsuitable for drinking. Septic drain tile fields should not be placed in organic terrain.

3.5 EOLIAN:

Examples:

$$\frac{\text{sED(pOT)}}{\text{Lp-D(M)}} \qquad \frac{\text{sED/sGO(pOT)}}{\text{Lp-M}} \qquad \frac{\text{sGO(sED)(pOT)}}{\text{Lnp-D(D)(M)}}$$

Eolian deposits (ED) of fine sand (s) occur in the northeastern corner of the map-area. The wind-blown deposits are derived mainly from glaciofluvial sand and form a blanket over other terrain units, usually outwash (GO) but also organic deposits (OT). Dunes occur in places, but are more prevalent outside the map-area to the north and west. Drainage varies from good to mixed (D-M) with a high water table in places (Dh), and the topography is low and planar (Lp).

Access roads are constructed very easily in eolian terrain, but the erosion potential is high once the protective vegetation cover has been removed. A high water table may limit excavations in places, and slumping and piping can occur. Driven well points will supply enough water for domestic use in eolian deposits below the water table. The pollution potential is high.

3.6 ALLUVIAL:

Example:

$$\frac{\text{sAP}}{\text{Lp-M}}$$

Alluvial plains (AP) occur along most river channels, but many are too small to map at the scale of 1:100,000. The alluvial plains along the Wenebegon River in the southeastern part of the area and along the Cow River in the northwestern part have been mapped and are composed primarily of sand (s). Silt (m) and peat (p) are also common in alluvium. Relief is low (L) and drainage is mixed (M).

The main engineering problems associated with the alluvial unit are foundation conditions and flood plain limits. Foundation conditions are generally poor, since materials are fine grained and water-saturated. Structures built on alluvial plains will be subject to flooding and would require suitable protection. Erosion potential and slope instability are high along stream banks. Groundwater potential is good in gravelly materials and poor in fine-grained materials. Alluvium is not suitable for waste disposal because of periodic flooding and the potential for pollution.

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